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University of Maine

Maine Agricultural Experiment Station

ORONO

BULLETIN No. 161

NOVEMBER, 1908

THE SADDLED PROMINENT.

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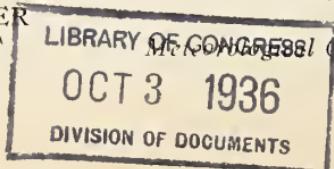
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BULLETIN No. 161.

THE SADDLED PROMINENT.

Heterocampa guttivitta (Walker).*

EDITH M. PATCH.

The present bulletin deals with a caterpillar outbreak so remarkable that the writer from sheer interest in it put aside other work so far as possible in order to keep in touch with the situation. Although a native insect the species under consideration has but occasionally been met with in the State, and prior to 1907 in numbers so slight that it had not seemed worth any special attention. The specimens of these caterpillars in the Station collection had not been determined except as to genus, never more than 3 or 4 inquiries had come concerning it during any one season and then it was reported only as scattered individuals found on apple trees.

ACKNOWLEDGMENTS.

During 1907 and 1908 numerous items have been sent in from people all through the infested areas which has added to the interest of the investigation. Some of the aid which has been given in this matter is herewith acknowledged in appreciation by the Station. Mr. Allen H. Jordan of Upper Gloucester has furnished pupæ for much of the parasite breeding and has for two seasons acted as guide into infested forest growth with which he is familiar. Mr. Fred R. Jones of Mercer aided materially with the investigation in that part of the State. To Mr. Dayton Edwards is due most of the molting records and the information concerning the conditions at Upper Gloucester, Sebago Lake and North Fryeburg, July 11-July 17. The bird observations were made by Mr. William C. Woods who also aided in the collection of parasites. Mr. Perley Skofield's assistance made much of the insectary work possible.

* Papers from the Maine Agricultural Experiment Station: Entomology No. 31.

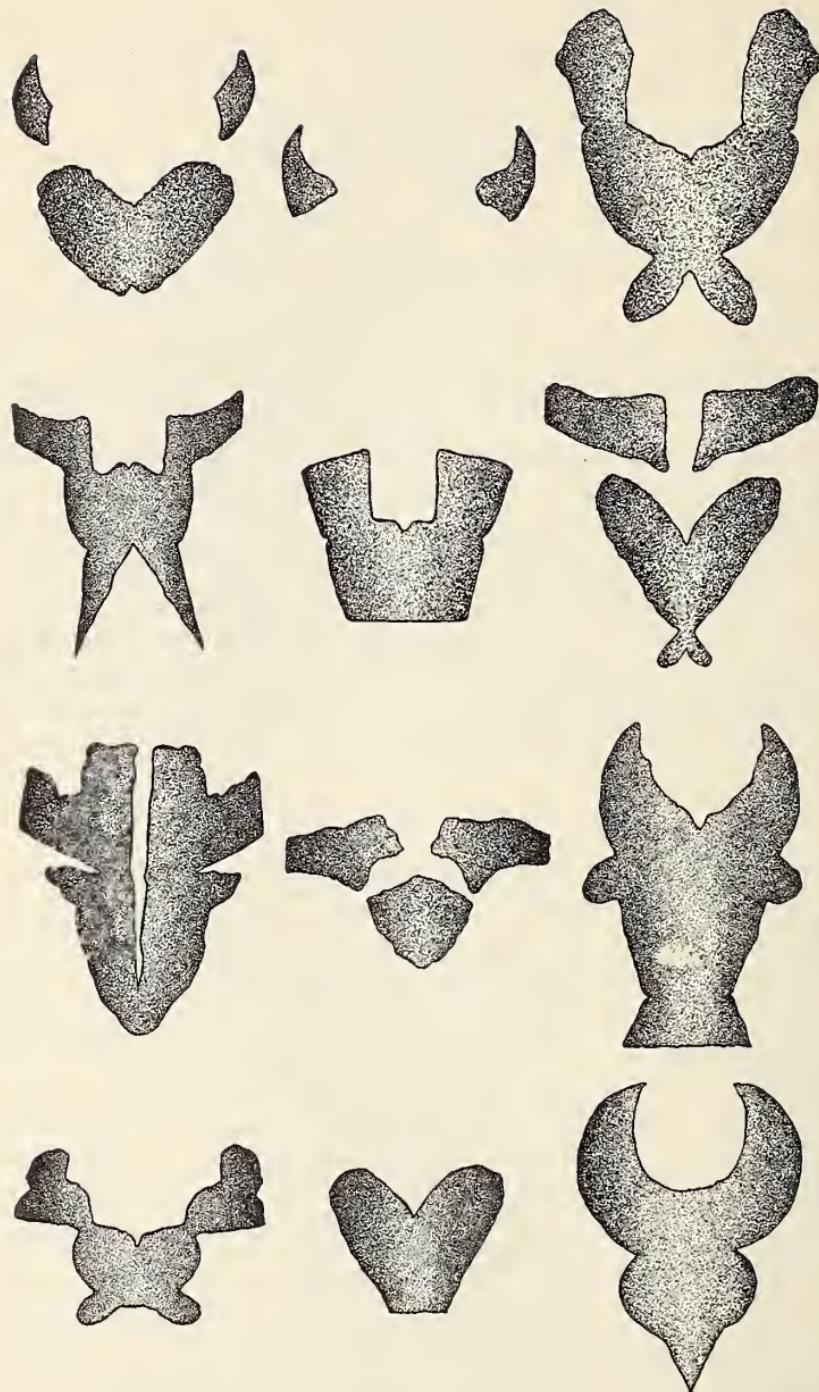


FIG. 14. Saddle marks of saddled prominents in third, fourth and fifth instars, showing a few of the innumerable patterns of this dorsal design. Drawn by Mr. R. L. Hammond.

DISCUSSION OF NAME "SADDLED PROMINENT."

Since Walker named the species in 1855, *Heterocampa guttivitta* has not attracted enough attention to have been given a common name. It has not, to be sure, lacked variety in classical designations, having been discussed under at least five generic and seven (partly by error) specific names.*

The thoroughgoing attack which it has made on hardwood forests from New York to Maine the past two seasons, however, brings it conspicuously before the public and the lack of a common name is an inconvenience. This inconvenience was met tentatively this season both by the Maine Experimental Station and the Maine Department of Agriculture by the designation "beech prominent," a name very naturally suggested by the noticeable preference of this insect for the beech for the past two seasons in Maine. There is, however, an obvious objection to dubbing a more or less general feeder with the name of its favorite plant, and "beech prominent" did not for this reason seem desirable.

"Antlered maple caterpillar" ** has been suggested, but for

**Heterocampa guttivitta* (Walker).

Cecrita guttivitta Walk., Cat. Lep. Het. Brit. Mus., v. p. 992, 1855. *Drymonia mucorea* Herr.-Schaeffer. Samml. aussereur, Schmett., fig. 514, 1856. *Lochmaeus cincereus* Pack., Proc. Ent. Soc. Phil., iii, p. 372, 1864. *Misogada sobria* Walk., Cat. Lep. Br. Mus., xxxii, p. 450, 1865. *Heterocampa doubledayi* Scudder, in Harris Ent. Corresp., p. 134, 1867. French, Can. Ent., xii, p. 83, 1880. Sixth Ann. Rep. S. Ill. Normal Univ., p. 661, 1880. Packard, Bull. 7. U. S. Ent. Comm. Ins. Inj. Forest Trees, p. 46, 1881 (Quotes French's description). *H. guttivitta* Grote, New Check List N. Amer. Moths, p. 19, 1882. *H. pulverea* Pack., Fifth Rep. U. S. Ent. Comm., p. 159, p. 397, 1890. *Lochmaeus olivatus* Pack., Fifth Rep. U. S. Ent. Comm., p. 39, 1890. *H. pulverea*, Proc. Bost. Soc. Nat. Hist., xxiv, p. 548, 1890 (*H. pulverea* by error). *H. guttivitta* Dyar, Psyche, vi, p. 178, 1891. (Fourth and last larval stages; cocoon and pupa.) (*H. guttivitta* Smith, List. Lep. Bor. Amer., p. 31, 1891. Kirby, Syn. Cat. Lep. Het., i, p. 564, 1892. *Cecrita guttivitta* Neum. and Dyar, Trans. Amer. Ent. Soc., xxi, p. 207, 1894; Journ. N. Y. Ent. Soc., ii, p. 117, Sept., 1894. *H. guttivitta* Packard, Mem. Nat. Acad. Sci., VII, pp. 230-235. Plates. 1896. *H. guttivitta* Beutenmüller, Bombycine Moths of Vicinity of New York City. Bul. Amer. Mus. Nat. Hist., X, p. 425, 1898. *H. guttivitta* Lugger, Univ. of Minn. Agric. Exp. Sta. Bul. 61, p. 171 (quotes Beutenmüller's description) 1898.

** Dr. E. P. Felt, Journal of Economic Entomology, Vol. 1, No. 2, p. 150. (Also N. Y. State Ent. 23 Rep't pp. 21-23 which appeared while this present bulletin was in press.)

this outbreak in Maine, at least, the species has shown a decided preference for beech. The antlers (See Figure 16) are lost after the first few days of its life when it is very tiny so that this would not seem a fortunate popular name for a caterpillar which comparatively few people would even see until the antlers had been shed. Then too, other closely allied species bear antlers as young larvæ, and *Heterocampa biundata*, which retains them through three stages, feeds also upon maple.*

The "purple marked forest caterpillar" ** would seem more descriptive of the older caterpillars, though the dark markings on this species in Maine while exceedingly variable were more uniformly reddish brown than purple. The careful larval descriptions of Doctor Packard* and Doctor Dyar *** indicate that purple marked caterpillars were also the exception among those examined by them, the former not mentioning purple and the latter describing it in that color for "a peculiar variety of *guttivitta*." It is very difficult, however, to strike upon a stable name for a variable species and except for the length of "the purple marked forest caterpillar" this name might be a convenient designation.

The family *Notodontidae* to which the species in question belongs has been popularly named "The Prominents."

"In some species the front wing has a prominence or backward projecting lobe on the inner margin, which has suggested the common name of Prominents for these insects. The name is more generally appropriate, however, for the larvæ, as a much larger proportion of them than of the adults bear striking prominences." ****

We have among related species popular names based upon larval characteristics as "unicorn prominent," "long-horned prominent," and "saddled prominent," seeming appropriate and convenient enough a name, has been settled upon mutually by the Maine Experiment Station and by the Maine Department of Agriculture, in order that it may bear but one popular appellation in this State.

* Packard. *Bombycine Moths*.

** E. D. Sanderson, *Newspaper circular*. August, 1908.

*** *Psyche* VI, p. 178, 1891.

**** J. H. Comstock, *Manual for the Study of Insects*, p. 263.

The term "saddled" is suggested by the position of the most conspicuous of the dorsal markings. In different designs this saddle mark appears near the end of the second larval stage and persists through the third, fourth, and fifth stages, that is, it is present from the time the caterpillars are 8 or 9 days old until they are full fed. The saddle mark occurs on the mid dorsal portion of the third abdominal segment, and extends in most cases over the fourth and on to the fifth. Like all the markings in this species the saddle mark is subject to great variation and is sometimes exceedingly faintly traced or absent in the fifth instar. The saddle designs which accompany this discussion are drawn from specimens in the third, fourth, and fifth instars and represent only a few of the countless variations.

We have among the slug caterpillars the "saddle-back caterpillar," *Sibine stimulea* Clem., but with the family name *Prominent* retained there is certainly no danger of a confusion between the names of these two exceedingly dissimilar species.

THE PRESENT OUTBREAK.

About the middle of August, 1907, the Station mail was flooded with complaints of this caterpillar which had made startling inroads in certain localities.* Two of these localities were visited immediately,—a large maple grove at South Leeds and approximately 100 acres of beech growth at Upper Gloucester being found at that time defoliated. The full fed caterpillars were observed to be vigorous and forming apparently healthy pupæ, so that a more serious attack was feared for the present season. With this in view the last of May, 1908, the writer made an initial trip into regions known to be infested the previous August, and frequent trips for observation were taken to certain of these localities from southwestern part of Oxford county to the southern part of Piscataquis county, during the entire caterpillar season. Insectary observations have also been made on this species through the entire life cycle.

While for the most part only enough attention could be paid to this species to accumulate a miscellany of observations, the work has resulted in some definite data not previously known for this species. The fact that for Maine only one brood occurs, the unbroken series of molting records for the same lot of cater-

* Me. Agr. Exp. Sta. Bul. No. 148. Insect Notes for 1907.

pillars, and the notes on parasites, the description of the egg, and several other observations in regard to the life cycle, seasonal history, and habits have not been previously published. In fact from an economic standpoint this species has never demanded consideration* before this present outbreak and except for careful descriptions very little attention has been given it. It is included in Packard's Forest Insects in two places (in both incorrectly determined). This season, however, the attack has occurred seriously in Vermont, New Hampshire, and New York, at least, besides this State; and doubtless much data of interest will come to light over so extended an area.

DESCRIPTION OF THE SADDLED PROMINENT.

The descriptions which follow are made entirely from specimens bred in Maine during this present outbreak. They are, however, written with reference to the descriptions of Doctor Packard whose diction is used wherever convenient.

Moth, female. Ground color olive-greenish ashen with cream white patches and black markings. Fore wings with a marginal black line broken at the veins by a pale dot. The marginal fringe is ashen with darker lines extending from the region of the veins giving the wings a border of shallow scallops. There is a submarginal series of 6 to 8 dark spots. Discal mark a curved dark line inclosed in a lunate pale space. In some specimens this pale space extends beyond the median dark zig-zag line far enough to enclose the row of submarginal dots. The body is 20 mm. long and the wings expand 40-52 mm. Figure 24 gives the female actual size and presents a better general idea of the markings than a detailed description.

Moth, male. Ground color of both wings darker than with the female, and the markings are less distinctive. Figure 23 was photographed from a particularly dark individual. The body is 20 mm. long and the wings expand 40-45 mm.

Both sexes are variable in markings.

**H. guttivitta* was included in a list of 356 apple insects by Lintner (N. Y. State Ent. 11th Rep't, p. 265) and an interesting portion of his introductory statement seems, in light of this present outbreak, to sound a note of prophecy:—"It is hardly necessary to state that not all the species herein recorded are to be regarded as specially injurious to the apple tree and its fruit but as each one is known to make it, at times, its food plant from choice (many others will feed upon it in confinement) the least harmful among them may at any time, through such sudden and inexplicable multiplication as is often witnessed in the insect world, become a serious pest."



FIG. 15. The Saddled Prominent.



FIG. 16. First Instar.



FIG. 17. Second Instar.



FIG. 18. End of Second Instar.



FIG. 19. Third Instar.



FIG. 20. Fourth Instar.



FIG. 21. End of Fourth Instar.



FIG. 22. Fifth Instar.

Larval stages of saddled prominent. After Bridgham. From Plate XXXI Bombycine Moths A. S. Packard. Memoirs of the National Academy of Sciences. Actual size indicated by lines under figures.

Egg. Pale pellucid green, the color of the ribs of the beech leaf. It is circular in outline with a diameter of 1.19 mm. The surface which is applied to the leaf is flat and the exposed surface is an unsculptured convex. The eggs are deposited singly and adhere firmly to the leaf.

Larva. In this stage the insect defies description particularly in the last instars as the dorsal pattern is exceedingly variable. In the first instar the species is characterized by 9 pairs of horns. In the latter instars the caterpillars may be in general described as green with dorsal longitudinal lines of various colors variously interspaced with designs of various shapes and colors. Such a description would at least convey an idea of the most striking characteristic of these larvae,—their high degree of variation as to markings. The most nearly constant of these is a reddish brown spot on the back of the caterpillar. This, the writer has designated as the saddle mark from its position and in some cases its form. The saddle designs figured in the bulletin were drawn from the specimens reared or collected during the summer of 1908, and give a suggestion of the variation of this mark no one of which seems to be exactly like any other. Those caterpillars which cannot find an original design for their saddle evade the responsibility by appearing with no saddle at all. Following is a description which will perhaps serve the present purpose. The form is illustrated by the accompanying figures and the size indicated by the hair line under them.

Larva. First Instar. Figure 16. Body and abdominal legs dull dark red,—head darker red. True legs black. Nine pairs of black horns occur along the mid dorsal line, each situated on a black enameled spot. The first pair just back of the head are much the largest and branched so that they have the appearance of antlers. There are no horns on the second and third thoracic segments or the seventh abdominal segment. The caudal end of the abdomen is held in an elevated position.

Larva. Second Instar. Figures 17 and 18. Body and head dark rose pink. The dorsal horns of the first instar have disappeared and are represented merely by two straight pointed projections on the first thoracic segment and by a pair of very minute points on the first, second, third, fourth, fifth, sixth and eighth abdominal segments. These minute points are black and are situated on a greenish brown mid dorsal spot.

Larva. Third Instar. Figure 19. Body green marked with bright reddish brown, except for slight tubercles representing the prothoracic horns. The body is smooth. The head is conspicuously large at the beginning of the instar with a broad pale reddish band on each side.

Larva. Fourth Instar. Figures 20 and 21. Body green with dorsal reddish brown markings varied. Head large with broad lateral band composed of 4 stripes colored black, white, pink, and yellow.

Larva. Fifth and last Instar. Figure 22. Body usually beech leaf green with a bluish cast, though some are brownish and some vary from straw to almost lemon yellow and others from lavender to deeper purple. (These were insectary caterpillars which had not been exposed to the direct rays of the sun.) The dorsal pattern was not exactly alike in any two of the caterpillars bred, varying from a pale design in whitish yellow

in some individuals to a heavy marking in reddish brown or purple in other individuals of the same age. Usually the third thoracic segment bears a dark oblique lateral mark with the ventral end slanting cephalad and the sixth abdominal segment bears a similar mark with a ventral slant caudad. Both these marks are sometimes missing and very often other similar marks are present on other segments.

This species would be a fascinating subject for a study in variation but nothing could really be done with it without the constant service of both a photographer and an artist to reproduce the intricate designs in color as no description could serve to fix them adequately.

Cocoon. Figure 26. The cocoon is formed by a very thin layer of silk usually lining a place hollowed in the leaf mould at the base of the infested tree. Sometimes the cocoon is firm enough so that it can be removed with the particles of earth attached as with the specimen photographed.

Pupa. Figure 25. Within the cocoon is a dark glistening brown pupa about 19 mm. long. Just caudad of the mesoscutum is a curve of 8 dull unpolished tubercles, the two at the ends being triangular, and the other six being nearly square. The terminal spines of the cremaster are somewhat boot shaped,—the toe being turned laterad and the heel mesad.

SEASONAL HISTORY.

Packard records the following dates for this species.*

"The eggs were found at Brunswick, Maine, as early as July 3, and it hatched July 11 or 12. Other larvæ, as observed in Maine, hatched about the 8th to 10th of July, feeding on the under side of the leaf, at first eating away a little irregular patch. Stage I lasts 9 days, Stage II probably 4 or 5 days. The last stage is reached a month later, August 9-10; one belated individual occurred on the oak at Providence as late as September 20 to 24.

Riley notes larvæ as occurring in July, and captures of the moths in May, June, July and August."

Doctor Dyar gives the species as "occasionally double brooded" ** and Mr. Beutenmüller says the species "is not common and possibly double brooded." ***

In view of these records the calendar for *H. guttivitta* during the past season's outbreak in Maine is of particular interest.

May 27, 1908, the writer visited a beech growth at North Fryeburg, Maine, which had been stripped by *H. guttivitta* the

* Bombycine Moths, page 234.

** Psyche VI, p. 179. 1891.

*** Bombycine Moths of Vicinity of New York, p. 426.

Male.



FIG. 23. Male.

Female.



FIG. 24. Female.

Moths of saddled prominent which emerged May 29, 1908. See page 325.



FIG. 25. Pupa.



FIG. 26. Cocoon.

See page 322.



FIG. 27. Characteristic posture of larva resting on molting mat on beech leaf. The head molt has already taken place. Change from fourth to fifth instar. See page 328.

previous season to secure pupæ and was surprised to find the moths already emerging in great numbers in the woods. Several hours were spent collecting pupæ, an easy matter in this thickly infested region. Many moths emerged on the way to Orono but enough pupæ were secured for ample material for the life history cycle.

May 29. Moths deposited eggs upon the beech leaves with which their cages were supplied.

June 7. First instar. Larvæ began hatching and in great numbers.

June 11-12. Beginning of second instar. The larvæ spinning their molting mats on the cage and leaves June 11 and molting during the night.

June 16-17. Beginning of third instar. The mats being formed June 16, and the molt occurring during the night and June 17.

June 23-24. Beginning of fourth instar.

June 30-July 2. Beginning of fifth instar. Last stage.

July 13. The first larvæ observed to be forming pupal cells in the earth provided for them. These pupated promptly.

October 7 the date on which this bulletin goes to press, no moths have emerged from these pupæ though the pupæ are alive as evidenced by their vigorous movements on being disturbed. The pupæ were kept in the insectary under leaf mold where the temperature does not vary appreciably from that out of doors.

This record should settle the question of a double brood for Maine. If moths emerging so early as May with the succeeding larvæ full fed in mid July do not give two generations (and the summer was particularly warm and dry) there would seem to be no possible chance for two broods in this latitude.

That this species is very susceptible to temperature control is evidenced by the fact last winter that from pupæ which were wet and warmed in the laboratory moths emerged December 3, 1907.*

Individuals hibernating in a place which did not warm up early in the spring might easily be a month or so later in emerging which would give late larvæ and conversely exceedingly early individuals to emerge in the spring might perhaps make

* Me. Agr. Exp. Sta. Bul. No. 148, 1907.

possible the cycle to the moth stage the same season. Thus farther south two broods may occur.

Weather conditions may account in part for the fact that in 1908 this species was pupating about the time of month that Packard records newly hatching caterpillars,—mid July; or for the larvæ of the first instar at Upper Gloucester this season on July 11.

The insectary observations were made with ample material. There were 175 female moths which emerged in captivity. A very conservative estimate of caterpillars hatching from the eggs these deposited would be 8,000 or 9,000. (See page 331) No count of the caterpillars in the first instar was made and most of them were destroyed at that time after retaining several hundred for the breeding observations. They were healthy in captivity and an easy species to rear. They were fed entirely upon beech. The foregoing record is for the earliest of the larvæ, a group of about 50 of the first hatching being caged together for detailed data as to molting. For the later larvæ, molting records were not kept.

Pupæ collected at Upper Gloucester, June 1, 1908, and sent promptly to the Station, emerged to a great extent on the way; The last of May to early June seemed a fairly uniform date for the greatest number of emerging moths this season.

As a check upon the insectary data a tour of largely infested areas was made as follows:

July 11 at Upper Gloucester specimens from the first to the fourth instar were found but the majority of them were in the third. They appeared in general smaller than were those reared in the insectary at the same stages,—a fact possibly explained by the food supply which was abundantly furnished to the captive caterpillars while those at liberty at Upper Gloucester had comparatively stripped the beech over 100 acres or more and were in many cases starving to death.

July 15. A devastated area of approximately 150 acres of maple and beech was visited at North Fryeburg where the caterpillars were observed to be a little older than at Upper Gloucester.

July 23. Upper Gloucester was visited again. Where caterpillars had been thick 12 days before very few were now to be seen. In some places they were traveling up and down the

trunks of stripped trees and it was in such places that the predaceous *Podisus* (see Fig. 37) was seen to be busy stabbing the larvæ and the pile of dead and half sucked caterpillars at the bases of trees where these bugs were at work gave good evidence of their appetites. Some larvæ were dying evidently from exhaustion and starvation after traveling up and down many trees and finding no food. Nearer the outskirts of the devastated area the caterpillars were faring better as they got off into fresh growth and were feeding vigorously. Those which were observed were in their fifth (last) instar.

July 24. Sebago Lake, Cape Raymond. The caterpillars were in their fifth instar, healthy and feeding.

July 27. Norridgewock. Caterpillars in the fifth instar, some feeding and some pupating, for the most part healthy.

July 28. Mercer. Pupated in some localities. In others caterpillars in the fifth instar feeding, a few beginning to die. (See a contagious fungus disease p. 344).

July 31-August 1. Norridgewock. Some healthy caterpillars feeding; many sick and dying.

August 3-4. Mercer. Dead caterpillars present by thousands and only a few live ones seen in two days.

Aug. 5-7. Norridgewock. Collection of pupæ which were in certain localities numerous.

August 8. Sebago Lake. *Heterocampa guttivitta* had already pupated in apparently healthy shape. Other species of larvæ which were about at the time were fungus attacked.

August 10. East Sangerville. Caterpillars still feeding, though many were full fed in this locality July 26.

August 14. Buckfield. Larvæ still feeding.

SEASONAL HISTORY SUMMARY.

For Maine the saddled prominent has but one brood. The moths in 1908 emerged in greatest numbers late in May and early in June. Oviposition begins soon after mating which occurs the first night after emergence.—The eggs hatch in about 9 days and the larvæ become full grown in 5 weeks (or more according to weather conditions and food supply). During this time they molt four times. The full grown larvæ enter the ground for pupation. In Maine this season pupation took place from mid July to late August, the majority of larvæ burying

late in July. They pass the winter in the pupal stage, under the leaf mold and the moths emerge in the spring.

HABITS.

The eggs are deposited singly by the female which in captivity applied the eggs to both sides of the leaf. From the reason that during both years over the whole range of the infestation the *tops* of the trees were stripped first and then the lower branches it is to be concluded that the moths by preference deposit the eggs upon the upper leaves. Perhaps the same tendency to fly high may account in part for the fact that the hillside forests were in general more largely attacked than the lowlands, which was noticeable throughout the infested districts.

An interesting feature was noticed in the feeding habits of the larvæ. The young caterpillars just hatched fed, as do the young of many species, from the surface of the leaf skeletonizing it in spots by nibbling out the parenchyma and leaving even the finest veins untouched. (See Figure 28). This habit was continued through the first instar but after the first molt the caterpillars migrated to the margin of the leaf and the meals during the second instar were obtained by eating down between the veins as indicated by Figure 29. In the third instar the feeding habit of the caterpillars is represented by Figure 30. After that Figures 31 and 32 are significant illustrations.

The saddled prominents do not cling tightly to the leaf or branch. Even in the first instar the caudal portion of the body is elevated,—the species from the first observing that characteristic family trait. A slight jar will dislodge the caterpillars from their hold and bring them rattling to the ground. (See also Combatative Measures page 349). They then climb the trunk and go to work again.

Before each of the four molts they carefully spin a thin, broad resting mat where they cling during the molt. At such times the larva usually waits with the head curved to one side as shown in Figure 27 where it will be noticed that the head molt has just occurred.

The full grown larva drops or climbs to the ground and constructs a cell in the earth or under the leaves at a distance of one to 3 inches below the surface. This cell is oval and is lined

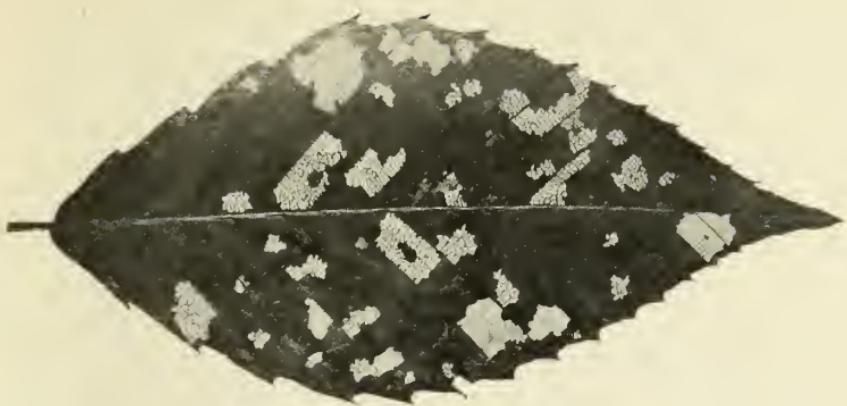


FIG. 28.

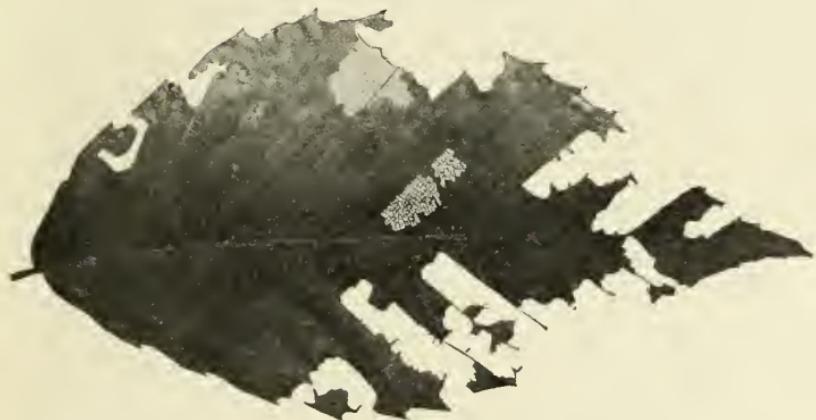


FIG. 29.

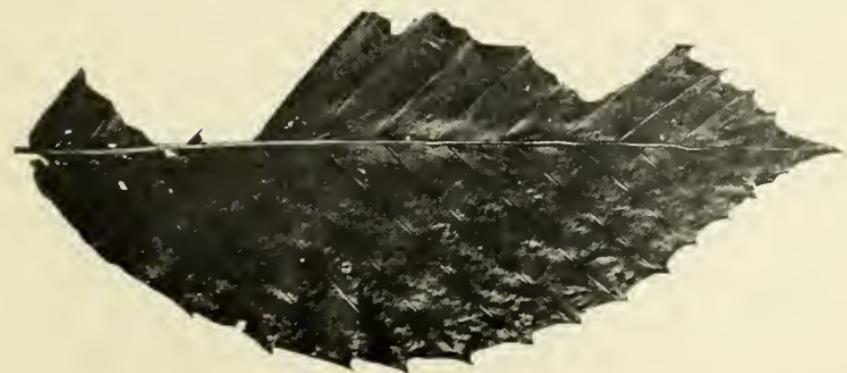


FIG. 30.

Beech leaves showing work of saddleback prominent in first, second and third instar respectively. Reduced. See page 328.

by a thin spinning of silk. The structure is hardly worthy the name cocoon as it is easily broken in throwing back the leaves and the loose pupæ exposed. Sometimes, however, a fairly stable cocoon is constructed and such a one to which particles of earth have adhered is shown in Figure 26.

The insect after remaining in the pupal stage all winter emerges with the warm spring days. On May 27 the writer observed great numbers of these moths breaking through the leaf mold during the warm afternoon and creeping up some convenient object while their wings expanded.

During captivity the moths mated the first night and began laying eggs soon afterward. The length of life of an individual moth could not be estimated as the captive moths break their wings and otherwise disable themselves usually before all their eggs are deposited. As to the number of eggs laid by a single moth the following record is of interest. June 3, 1908, one female freshly emerged was dissected and the eggs in the ovarian tubes were counted. They varied from 55 to 75 in the different tubes of which there are 8, and the total number for this one moth was approximately 500 eggs. Later 12 females that had died in the cage were dissected and the unlaid eggs remaining in the egg strings were counted. The total number of unlaid eggs was 629 giving an average of 52+ of unlaid eggs to each moth. In some individuals only 5 to 6 eggs remained. In 3 individuals the number of unlaid eggs was between 125-150, however, a condition doubtless due to the moths beating themselves to death before they finish depositing eggs, in their attempts to get out of the cage.

FOOD PLANTS.

Beech leaves have been unquestionably the favorite food of this species during the two years attack in Maine. Over about 800 acres on Frye's Island, Sebago Lake, and about 800 acres on Cape Raymond, the beech was completely stripped, the birch being taken later. At Upper Gloucester the beeches were taken first these trees being defoliated over 100 acres by July 11. At this time maple and oak had been in some cases stripped but the white birch was at that time practically untouched. By July 23, however, the birch had succumbed also.

Isolated maple groves as well as maples present with beech in forest growths were stripped often by the saddled prominent

alone and sometimes helped out by the green striped maple caterpillar, *Anisola rubicunda*, which has been for two years very numerous. Similarly the attack by the saddled prominent on the oaks was reinforced by the rosy-striped oak-worm, *Anisota virginiensis*.*

As to what happened to apple orchards in the infested districts Figure 32 is sufficient explanation.

Yellow birch seemed avoided at first and several reports came in "everything stripped but yellow birch" but larvae of this species were seen actively feeding upon the yellow birch at East Sangerville and elsewhere later in the season.

Sumac was in several instances reported stripped but in every case investigated by the writer this was due to an undetermined small green caterpillar which made a general raid of the sumacs this season.

Saddled prominents were observed to be feeding also upon witch hazel, poplar, blackberry, mountain maple, spirea, cherry, and undoubtedly a full list of food plants would be very long.

The order in which various species of trees were taken seemed to vary in different localities but everywhere the beech was given preference.

The following extracts from letters give the food plants most attacked and are indicative of the extent and time of most conspicuous infestations. In each case the inquiry was accompanied by specimens of the saddled prominent.

July 18, 1908. Douglass Hill, Cumberland County, Maine. "Sunday they stripped fully 50 acres of forest trees here and are still at work very rapidly. They are also on apple trees."

July 28. Dover, Piscataquis County. "I am sending several worms taken from maple trees. They are eating the leaves from the tops or seem to work more in the top. May work downward later as I have just discovered them."

July 14. Bridgton, Cumberland County. "Some green worms are covering our apple trees in large numbers and are doing great damage."

July 16. Naples, Cumberland County. "What species of worm are these on nearly all hardwood and fruit trees? Beeches seem to be the ones they prefer."

* See Maine Agric. Experiment Station Bulletin No. 162, Insect Notes for 1908.



FIG. 31. Work of the saddled prominent in beech growth. Photograph taken at Upper Gloucester, Me., July 23, 1908.

FIG. 32. Orchard stripped by the saddled prominent, on the estate of J. H. Jones & Sons, Hampshire Hill, Mercer, Me., July 20, 1908. Photograph loaned by Mr. Fred R. Jones.



July 16. Lovell, Oxford County. "The green worms have stripped whole orchards of leaves."

July 19. Sebago Lake, Cumberland County. "I first saw these worms in this section last spring when they began attacking the beech, birch and maple on several hundred acres. This year they have become much worse."

July 20. New Sharon, Franklin County. "These caterpillars have eaten off all the foliage from many of the trees, both apple and hardwood. They are especially prevalent on beeches."

July 20. Stark, Somerset County. "These caterpillars are stripping the hardwood trees in this part of the town."

July 20. N. Waterford, Oxford County. "Some green worms are eating *all* the leaves on the apple trees and take the maple and beech."

July 20. Shapleigh, York County. "They have stripped the leaves from 100 acres of forest, and are also working on fruit trees."

July 20. Livermore Falls, Androscoggin County. "I send specimens of green worms which are devouring both shade and fruit trees."

July 21. Lovell, Oxford County. "Am sending a box of *Heterocampa guttivitta*. They have proved very destructive in this vicinity. Several hundred acres having been traversed by them and are almost devoid of leaves. Our orchard is practically ruined for this year at least. Our shade trees are bare as winter except elm and oak."

July 21. Livermore Falls, Androscoggin County. "Several hundred acres have been so defoliated that they present a brown appearance like that of bare trees in winter. The caterpillars seem to prefer the beech and birches, but are also very numerous on maples and oaks and may be found on other trees."

July 22. Madison, Somerset County. "The worms are doing considerable damage, working chiefly in the top branches."

July 22. Norridgewock, Somerset County. "They are partial to beech and yellow birch."

July 22. Harrison, Cumberland County. "The forests in the south part of Harrison and the adjoining town of Naples are in an alarming condition. The beeches are as bare as in December. White birches, oaks and maples are suffering severely."

Apple trees are in a leafless state also. The same condition prevails across the lake in Bridgton."

July 23. N. Waterford, Oxford County. "I am sending you worms that belong to an army which are destroying all the hardwood save the poplars within about seven miles of here. Last year they started to eat in the town of Sweden cleaning up the woods so that with the exception of the poplars and evergreens they looked as bare as in late fall. This year they ate everything that leaved out in the old neighborhood and began to move toward us through the woods in great quantities. They are moving half a mile a day. They seem to crowd along the ground in swarms as soon as they strip one section of woods."

July 23. Bethel, Oxford County. "The worms have eaten the leaves all off about 500 cords of wood and they are so thick they can be gathered by the bushel."

July 23. Hiram, Oxford County. "I send you specimen of a worm that is eating the hardwood growth, stripping the trees over thousands of acres in a place."

July 24. N. Leeds, Androscoggin County. "Forests look as though a fire had swept through."

July 24. Freeport, Cumberland County. "Beech trees seem to fare the worst."

July 24. Shapleigh, York County. "A caterpillar that is destroying acres of woodland and apple trees."

July 27. Wiscasset, Lincoln County. "I am sending you green worms which have stripped the beeches and yellow birches completely and have nearly stripped the white birch and are now beginning on the maple."

July 28. Sebago Lake, Cumberland County. "They are eating beeches, oaks and birches. White maple and sugar maple have escaped so far. They begin at the top of the tree and work down until there isn't a leaf left upon the tree, they then drop to the ground with a thud and crawl to some other tree. The woods are full of them on the ground and they are traveling at a fearful rate."

July 29. Ross Corner, York County. "The Prominent (*H. guttivitta*) is doing the most damage, the one I send you on oak (*Anisota virginiana*) comes next and the maple leaf caterpillar (*A. rubicunda*) last. Probably 100 acres of trees are all bare."

July 31. So. Paris, Oxford County. "They seem to prefer

beech, birch and maple. They strip a tree clean of leaves and take tree after tree."

August 1. Fryeburg, Oxford County. "The wretched infestation of these worms make life in the country difficult and destroy the pleasure of my hitherto beautiful summer home."

August 1. Gardiner, Kennebec County. "Worms that are destroying the foliage of beech, maple and birch in the forests."

August 5. Sebago Lake, Cumberland County. "I was in the woods yesterday and there are scarcely any of the Prominents to be found in the trees now."

DEGREE OF INJURY DUE TO THE SADDLED PROMINENT.

The question uppermost in the minds of owners of infested woodland is whether the stripped trees will die. While it is not possible definitely to predict the degree of injury caused by such an attack, the following statements are of interest in this regard. Weather is one controlling factor, hard winters, excessive drought, or other unfavorable climatic conditions occurring at the time of such a severe stripping of trees increase the danger of fatal results. Under ordinary conditions some species of deciduous trees will stand being stripped for 2 consecutive years, and recover from the shock. If other conditions are particularly favorable a 3 years seige may not prove fatal. Some species of trees will stand what others cannot. The beech growth at Upper Gloucester and North Fryeburg which the writer had under observation was thoroughly stripped in 1907 and leaved out heavily and well the following spring. At South Leeds, Mr. John O. Bates, at whose place a large maple grove was completely stripped by the saddled prominent both in 1907 and 1908 wrote on September 16, 1908: "The old growth maple all leaved out in good shape last spring. The leaves on the young maple tops were a pale yellow. This year the grove was stripped as bare as winter about the first of August. Last year the trees did not leaved out again after being stripped. This year the maples have all leaved out and some of the limbs of the beeches have leaved out."

Other reports that the trees, particularly the maple, were releaving came from various parts of Maine during late August this year.

The fact that in general the infested districts were stripped about 2 weeks earlier this year than last seems to be due to the greater number of caterpillars this season, many growths being devastated before the caterpillars were nearly grown. This was an unfortunate thing for the caterpillars as, except for such as could reach fresh growth, there was nothing for them to do but "drop out of the trees and keep going up until they died" as one observer put it.

NATURAL ENEMIES OF THE SADDLED PROMINENT.

Prophecy as to the condition of the caterpillars another season is as difficult as predictions concerning the state of the trees. There are, however, more definite statements to be made in this case.

INSECT ENEMIES.

Last year over widely separated regions the saddled prominent pupated in an apparently perfectly healthy condition. Predaceous bugs and beetles were numerous and fed upon the caterpillars to a considerable extent. Two counts were made for the proportion of parasites from pupæ collected this spring. From 255 pupæ collected at Upper Gloucester June 1, 1908, 190 moths emerged, and 15 parasites, the cause of death of the other 50 pupæ was perhaps largely due to injury in transmission or handling in laboratory. From 176 pupæ collected May 29 at North Fryeburg, 153 moths emerged and 5 parasites, the remaining 18 died probably from injury in transmission. In 1908 particularly about August 1, hymenopterous parasites were very abundant in the woods infested by the saddled prominent. Concerning about 40 species there is so far only such circumstantial evidence that they were present in regions infested by the saddled prominent and further observations will be made for these another season. *Pimpla pedalis* which passed the winter in the pupa of its host was bred by the writer from pupæ of *Heterocampa guttivitta* collected last spring and *Ichneumon sublatus** similarly bred was present this season in great numbers from North Fryeburg to Norridgewock, and was without question the most beneficial of the hymenopterous parasites.

* Determined by Mr. Crawford through the courtesy of the U. S. Bureau of Entomology.



FIG. 33. Male. FIG. 34. Male. FIG. 35. Female. FIG. 36. Female.

Ichneumon sublatus. The most beneficial parasite of the saddled prominent. See pages 340 and 343.



FIG. 37. *Podisus modestus*. Predaceous bug stabbing the saddled prominent. See page 343.



FIG. 38. Adult.



FIG. 39. Larva.

Calosoma. Predaceous beetle feeding upon saddled prominents.

Both sexes of this species are given as Figures 33, 34, 35, and 36. *Ichneumon sublatus* also emerged the middle of September from pupæ collected at Norridgewock the first of August. How many generations a year there are for *sublatus* in connection with the saddled prominent was not ascertained. The only seasonal data which can be given is that it passed the winter in the pupa of its victim and emerged early in June, that it was on the wing in great numbers (evidently freshly emerged individuals) the first of August in the infested regions and that the species also emerged in mid-September from pupæ of the saddled prominent. Of the various predaceous wasps, apparently attracted by the saddled prominent, species of *Ammophilas* were particularly abundant.

The larvae and adults of *Calosoma* were numerous in the infested woodlands at North Fryeburg, Upper Gloucester, Norridgewock and Mercer during the season. Both the beetles and larvae carried on an active warfare against the caterpillars and were found climbing the tree trunks for their prey though their supply of food was largely taken from the ground or a foot or two up the trunk. One of these beetles was, however, found on the branches of a small tree. Figures 38 and 39 illustrate two stages of this species.

The larvae of *Calosoma* are also active in feeding upon the buried pupæ of the saddled prominent and were particularly fond of the fresh pupæ the contents of which they were frequently found to be devouring early in August.

Pterostichus lucublandus was especially abundant last spring under beech trees where the pupæ were hibernating. These and other common ground beetles unquestionably take their part in feeding upon these caterpillars.

Of the predaceous bugs which were numerous, *Podisus modestus* was most active in feeding upon the caterpillars of the saddled prominent. Figure 37 gives this species in a fairly characteristic position with its beak plunged into the caterpillar (this species it usually attacks a little behind the head) and braced back while it drains the caterpillar fluids. Tree trunks where these bugs were working were decorated with dead caterpillars half sucked and hanging limp like an inverted U, and little heaps of dead caterpillars at the base of the trees testified to the ability of these blood thirsty bugs.

Some undetermined species of predaceous bugs were found near the saddled prominents but none were so numerous as *Podisus modestus*. As this bug also feeds upon the caterpillars of the brown-tail moth * it should be recognized as a benefactor of considerable significance.

No effort was made to secure evidence in regard to the host of insect eating animals. Mr. Curtis A. Perry, Bridgton, reports a pair of pet skunks as being very fond of the saddled prominents, eating them voraciously.

STARVATION.

Before the middle of July at Upper Gloucester and other badly infested places large areas had been already stripped. This happened in many cases before the caterpillars were ready to pupate and though the caterpillars sought new feeding ground, as was evidenced by stripping orchards (see Fig. 32). hordes of the caterpillars never reached suitable food and died of starvation. These starving caterpillars would drop from one defoliated tree and climb others only to find that no food awaited them. Many climbed trees they could not eat when nothing remained for them but to drop or climb down and try another. Figure 40 shows a mass of such caterpillars that had congregated about the base of a hemlock tree the foliage of which they could not eat.

CONTAGIOUS DISEASE.

Where excessive numbers of caterpillars are present in one place, favorable conditions arise for the spread of disease. Late in July and in early August various species of caterpillars were attacked by a disease and in some instances practically the whole infestation of saddled prominents was wiped out. At Mercer and elsewhere countless thousands of these caterpillars died within a few days. They lay in heaps about the bases of trees, in masses about stones, and hung limp where they had fallen across the branches. Specimens of these caterpillars were examined by Doctor Lewis, Associate Plant Pathologist of this Station, who found that the disease was due to a fungus parasite but that bacteria set in among the sick caterpillars and hastened their decay. The destruction of the bodies

* See Me. Agr. Exp. Sta. Bul. No. 162, Insect Notes for 1908.



FIG. 40. Starving saddled prominents congregated about base of Hemlock tree, the foliage of which they could not eat. Photograph taken in stripped beech growth, Upper Gloucester, Me., July 23, 1908. See page 344.

was thus so rapid that after a few days of heavy stench, nothing remained of the plague-stricken caterpillars.

In localities where the caterpillars died this season in this wholesale manner, it would seem that little need be feared from caterpillar attacks for the coming year.

In what manner the fungus disease started is not known. Possibly it found entrance among the wounded caterpillars that predaceous bugs had stabbed. In one or two localities there seemed to be some indication that such was the case. Once well started it would not be difficult for the disease to spread rapidly for the fungus penetrates throughout the body of the caterpillar, and the spores are thrown to considerable distance in all directions so that they light upon caterpillars below, or upon parts of the tree over which healthy caterpillars would travel. *Podisus modestus* was observed repeatedly in close proximity to diseased caterpillars, and it is not unlikely that such bugs would transfer fungus spores from sick caterpillars to healthy ones.

It is worth recording in this respect that this fungus outbreak came in a dry season. At Hampshire Hill, Mercer, for instance, it had rained but twice in the month (July 17 and July 27) previous to the height of the fungus disease which occurred July 28 to August 1. This severe fungus attack at Mercer occurred over an area the altitude of which was from 680 to 1020 feet, reaching the summit of the hill. Although it was a particularly dry season, various species of caterpillars were attacked by fungus all over the State about this time, though in many localities the saddled prominents had become full fed and safely pupated before the fungus developed.

BIRD ENEMIES.

As a rule soft bodied caterpillars are soon checked by birds. In order to form some estimation of the role birds were taking in the present outbreak, observations of badly infested areas were planned for this year. This could not be carried out until late July and early August, and it chanced that each place selected for the desired data was experiencing a wholesale fungus attack which naturally interfered with bird diet.

The following list of Maine birds, however, gives species which are undoubtedly beneficial. Of these 45 are reported as

observed eating hairy caterpillars* in Massachusetts and the remaining 8 related more northern species would without doubt have the same habit. Any bird that will eat a hairy caterpillar will take a naked caterpillar like the saddled prominent with relish.

Yellow Billed Cuckoo, Black Billed Cuckoo, Hairy Wood-pecker,** Downy Woodpecker,** Yellow Billed Sapsucker, Northern Flicker,** Kingbird,** Crested Flycatcher, Least Flycatcher, Phoebe, Wood Pewee, Blue Jay, American Crow,** Red Winged Blackbird, Baltimore Oriole, Bronzed Grackle, White Throat Sparrow, Chipping Sparrow,*** Song Sparrow,** Field Sparrow, Junco,** Towhee, Rose Breasted Grosbeak, Indigo Bunting, Scarlet Tanager, Cedar Waxwing,** Red-Eye Vireo,*** Warbling Vireo, Solitary Vireo,*** Pellow Throat Vireo, Black and White Warbler,** Nashville Warbler, Northern Parula Warbler, Yellow Warbler,** Black Throated Green Warbler, Black Throated Blue Warbler, Myrtle Warbler, Magnolia Warbler, Chestnut Sided Warbler, Ovenbird, Northern Yellow Throat, Northern Water Thrush,** Redstart, Catbird, Brown Thrasher, Winter Wren, White-Breasted Nuthatch, Red Breasted Nuthatch,** Chicadee,** Wilson's Thrush,** Hermit Thrush,** Robin,*** Bluebird.

In recording the efficiency of birds as natural enemies to the saddled prominent and other caterpillars, the domestic fowls should not be scorned. Turkeys and hens though not applicable to forest conditions are exceedingly helpful in the orchard or about shade trees. By way of example may be cited a hen of Buckfield which ate without much pause 60 of the caterpillars which dropped from a tree that was given a sharp rap. A case to the point also is recorded by State Entomologist E. F. Hitchings* concerning a chicken weighing when dressed 1 3-4 pounds. The crop of the little fowl was so distended that its contents were examined curiously and were found to consist of 75 full grown caterpillars compactly disposed.

* Forbush, E. H. *Useful Birds and Their Protection.*

** Seen in stripped woodlands in Maine.

*** Actually observed feeding on saddled prominent.

* Maine Dept. of Agric., Augusta. Circular of Information on Forest Insects, 1908.

COMBATATIVE MEASURES.

ORCHARD AND SHADE TREES.

For the orchard or shade trees there are several practical measures which have proven successful the past season in preventing serious injury from the saddled prominent.

Spraying. This species is susceptible to arsenical poisons and the caterpillars readily died on apple trees which were thoroughly sprayed. Arsenate of lead or Paris green will kill these caterpillars and should be applied as soon as they begin appreciable work. Applications from the middle to the last of June would probably get all these caterpillars which hatched upon the trees. In case a migration to an orchard from an infested forest growth is feared, the orchard should be sprayed as soon as the caterpillars begin to travel in search of fresh food. If trees not already attacked are banded with a sticky substance, the ascent of caterpillars up the trunk will effectually be prevented.

Jarring and banding. The saddled prominents are readily shaken from the branches. The writer repeatedly has seen trees effectually cleared in this way for the past two seasons. Small trees can be shaken from the ground. With larger ones a boy can be sent among the branches to shake or give them a sudden jar, a proceeding which should begin with the top, of course. The cool of the morning is the most propitious time for jarring.

The caterpillars once dislodged, their reclimbing can be prevented by banding. The trunks of the trees are protected with a sticky band. A band of tarred paper thickly smeared with equal parts of lard and sulphur has proven helpful in such cases. This mixture should not be applied directly to the bark of the tree as there is danger of injury, but with the tarred paper it is safe and effectual. Tar hardens so quickly that it has not proven satisfactory in several cases where it has been tried this season.

A material useful in certain phases of the gypsy caterpillar campaign and sold under the name of Tree Tanglefoot has been recommended by this Station during the present seige of saddled prominents. "This substance consists principally of resin softened by the admixture of suitable oils. It is quite similar to that used in the manufacture of adhesive fly paper, seems to

possess the merit of not injuring the trunks of trees, and is very effective in checking the ascent of caterpillars thereon."* Where the number of caterpillars jarred from the trees is excessive it is expedient to kill them. A hand spray charged with kerosene or gasoline is a useful means to this end.

Fowls and Pigs. Hens will devour these caterpillars greedily (see page 348) and if given the range of an orchard will eat great numbers of the caterpillars which drop to the ground or descend to pupate. Of course, where such an excessive infestation occurs as during the present season, it would not do to depend upon hens entirely but they would prevent great numbers from entering the ground to develop into next season's moths. A flock of turkeys would display even more commendable ability in this respect.

Pigs pastured in an orchard will, by rooting up and eating the pupæ, prevent great numbers of saddled prominents and other moths from emerging and depositing eggs for the following season.

FOREST TREES.

For such phenomenal outbreaks as the present no artificial measures are practical in forest growths. If the saddled prominents were likely to appear in excessive numbers year after year, wholesale spraying or other combatative measures might be advisably applied as with the gypsy caterpillars. But the saddled prominent, like other native species, is ordinarily held in check by birds, insect enemies, field mice and other animals which feed upon it in its various stages, by fungus diseases or by weather conditions. A moth ordinarily so guarded has never been known to remain uncontrolled by natural agents for more than a few years in succession, and in extensive woodland growths there is in this case apparently nothing to be done except to wait for natural conditions to readjust themselves.

*A. H. Kirkland. Second Annual Report of the Superintendent for Suppressing the Gypsy and Brown-tail Moths, page 150.

